among the text are some excellent reproductions illustrating the behaviour of different lenses and speeds of shutters, and the frontispiece is a contact print on Barnet platino mat bromide paper. The low price of the volume (one shilling) and the useful nature of the contents should render it indispensable to every photographer.

IN the current number of the *Comptes rendus* is a note by Prof. Henri Moissan on a new method of preparing the silicon analogue of ethane, Si_2H_6. This substance was originally obtained by the author, in conjunction with Dr. Smiles, by the partial condensation at $-200°$ C. of an impure silicon hydride prepared by the action of hydrochloric acid upon a silicide of magnesium of undefined composition. Attempts to prepare the same compound from the lithium silicide, Li_2Si_6, by the action of dry hydrogen chloride or a dilute solution of hydrochloric acid were unsuccessful, hydrogen being the only gaseous product. It has now been found that by the gradual addition of lithium silicide to concentrated aqueous hydrochloric acid, the silico-ethane is readily formed in abundance and can be separated by means of cooling to the temperature of liquid air.

THE same number contains an account, by M. F. Bodroux, of another application of the organo-magnesium compounds to organic synthesis. It has been found that if a magnesium alkyl chloride or bromide, prepared in the usual way by the action of magnesium upon an ethereal solution of the alkyl bromide or chloride, is treated with iodine, the alkyl iodide is produced in nearly quantitative yield, together with magnesium iodochloride or bromide. Propyl bromide and isoamyl chloride treated in this way have furnished about 80 per cent. of the theoretical quantities of the corresponding iodides. The reaction is equally applicable to aromatic derivatives, and will simplify greatly the preparation of many monoiodo-derivatives of benzene.

THE much-discussed question of the chemical character of bleaching powder is revived in a recent number of the *Zeitschrift für anorganische Chemie*, which contains a long paper on the subject by Herr Winteler, of Darmstadt. The investigation appears to have arisen from a difficulty which was experienced in making good bleaching powder from electrolytic chlorine, owing to the gas containing considerable quantities of carbon dioxide. The chief conclusions reached by Herr Winteler are as follows. Dry chlorine does not act on dry calcium hydroxide, but in the presence of moisture chlorine water is first formed. This contains hypochlorous and hydrochloric acids, which then act upon the calcium hydroxide. The action involves complicated equilibria, which depend on the temperature, the amount of water present, the rate at which the chorine is passed, &c. Bleaching powder possesses no definite formula, but is a mixture of bodies resulting from the balanced reactions just referred to. It contains basic calcium chloride and basic hypochlorite as normal components, and may contain chloride and hypochlorite as well as hydroxide and the free acids. The decomposition of bleaching powder into chloride and oxygen takes place when there is an excess of hydroxyl ions; on the other hand, an excess of hydrogen ions leads to a decomposition into chlorate and chloride. Working upon this theory of the character of bleaching powder, Herr Winteler shows how it is possible to prepare a good product even when using unpurified chlorine containing 6 per cent. of carbon dioxide.

THE additions to the Zoological Society's Gardens during the past week include a Fennec Fox (*Canis cerdo*) from North Africa, presented by Dixon Bey; two Common Marmosets (*Hapale jacchus*) from South-east Brazil, presented by Mr. J. B. Joel; two Egyptian Jerboas (*Dipus aegyptius*) from North Africa, presented by Miss Chesterman; two Eastern One-wattled Cassowaries (*Casuarius aurantiacus*) from New Guinea; a Blossom-headed Parrakeet (*Palaeornis cyanocephalus*) from India; a Gangetic Trionyx (*Trionyx gangeticus*) from India, deposited.

OUR ASTRONOMICAL COLUMN.

COMET 1902 *d*.—From observations made at Hamburg on December 3 and 11, and at Paris on December 22, Herr Ebell has calculated the following elements and ephemeris for this comet:—

T = 1903 March 23·544 Berlin M.T.

$$\left.\begin{array}{rl} \omega = & 5^\circ\ 43'\ 32''\cdot6 \\ \Omega = & 117\ \ 29\ \ 51\cdot2 \\ i = & 43\ \ 54\ \ 17\cdot4 \end{array}\right\} 1903\cdot0$$

$$\log q = 0\cdot443876$$

Ephemeris 12*h*. *M.T. Berlin*.

1903	α h. m. s.	δ ° ′	log Δ	Brightness.
Jan. 0	7 3 10	+3 47·3	0·2925	1·4
4	7 0 19	+4 54·1	0·2880	1·4
8	6 57 23	+6 4·6	0·2847	1·5
12	6 54 27	+7 18·2	0·2825	1·5
16	6 51 34	+8 34·4	0·2816	1·5
20	6 48 47	+9 52·6	0·2818	1·5

Unit brightness at time of discovery.

On December 22d. 10h. 44m.·3 Paris M.T., the comet was observed in the following position by M. Bigourdan at Paris:— α (apparent) = 7h. 9m. 7s.·4, δ (apparent) = + 1° 32′ 55″.

M. Fayet has found that this comet has the greatest perihelion distance recorded for any comet since that of 1729.

OBSERVATIONS OF VARIABLE STARS.—In No. 3837 of the *Astronomische Nachrichten*, M. M. Luizet, of the Lyons Observatory, publishes his observations of five variable stars and gives his results for each star in a tabular form.

The result of 285 observations of Algol, made between November 18, 1897, and March 12, 1902, indicates a possible slight negative correction to the elements published by Mr. Chandler in No. 509 of the *Astronomical Journal*.

One hundred and fifty-seven comparisons of the irregular variable ε Aurigæ indicate great irregularities in the brightness of this star, which on December 10, 1901, was actually one or two degrees fainter than ν Persei.

One hundred and fourteen comparisons of W Orionis were made between October 26, 1898, and March 19, 1902, and these show that both the duration of the period and the magnitudes at maxima and minima vary greatly. The following elements show the closest agreement to the observations:—

$$\left.\begin{array}{l} \text{Maximum 1899 February 22} \\ \text{Minimum 1899 March 10} \end{array}\right\} + 32\text{d.}\cdot 32\ \text{E.},$$

but there are several observations which are not reconcilable to this period.

Observations of T Monocerotis and ζ Geminorum have also been made, and tables of their maxima and minima are given by M. Luizet.

THE SPECTRUM OF ε AURIGÆ.—From the investigation and measurement of spectrograms obtained during 1901 and 1902 by Prof. Hartmann and Dr. Eberhard, Prof. H. C. Vogel has found that ε Aurigæ is a spectroscopic binary which has a very long period.

The spectrograms referred to show that the hydrogen lines in the violet region, beyond H and K, stand out with exceptional prominence in this star, and a close investigation as to the cause has led to the conclusion that the spectra of two stars—one of the α Cygni type, the other lying between the limits of Types I. and II. (α Persei, γ Cygni)—are present, the one being exactly superimposed on the other.

OBSERVATIONS WITH A BINOCULAR TELESCOPE.—In *Popular Astronomy*, No. 100, Mr. D. W. Edgecomb describes the performances of the 6½-inch binocular telescope, made by Messrs. Alvan Clark and Sons.

In describing the features of the Moon, Jupiter and Saturn as seen with the binocular, the writer states that the objects

present more detail, are brighter, and appear larger than when seen through an ordinary single telescope of the same aperture. In addition to this, the "seeing" is much steadier, and the stereoscopic effect obtained greatly enhances the beauty of the objects observed.

Such objects as Clark's companion to γ Lyræ, the companion to τ Orionis and the Mitchell companion to Rigel have all been steadily observed, and it is generally considered necessary to use an instrument of 7 or 8 inches aperture in order to see the last-named object.

The prisms used in this instrument are $2\frac{7}{8}$ inches long and $1\frac{5}{16}$ inches thick, the rays from the objectives traversing $5\frac{1}{2}$ inches of glass before reaching the eyepieces.

RECENT AMERICAN BOTANY.

MR. M. L. FERNALD[1] has published a very interesting review of the birches belonging to the groups *Betula alba* and *B. nana*. These trees and shrubs inhabit the northern regions of both hemispheres, and Mr. Fernald recognises in America seven species and seven varieties, of which six species and five varieties are common to the Old World. Thus, contrary to the opinion of some recent authors, the American white birches are mostly non-endemic, though exhibiting numerous apparently distinct forms. Not only is this true, but the admitted species intergrade all along the line. "It is quite possible to trace by a series of specimens a direct connection between the dwarf *Betula nana* or *B. glandulosa* and the tall *B. alba*. . . . But since it is obviously impracticable to regard all these forms as one species, it seems wiser to recognise the more marked centres of variation as species which are admitted to pass by exceptional tendencies to other forms ordinarily distinguished by marked characteristics" (p. 189). This, of course, brings up the question of the definition of species. The present writer has been accustomed to use the accompanying diagram in teaching biology. The line *a a* represents a species which is slightly dimorphic, as is indicated by the two prominences. The line *b b* represents a strongly dimorphic species, connected (at *b'*) by very few intermediates. The line *c c* represents a case in which the intermediates have died out, and there is a complete break (at *c'*) resulting in the formation of two species. It is now to be pointed out that this break must be spacial or geographical, and not merely morphological, otherwise the two sexes of the same species would often have to be regarded as distinct species. Such a break need not be geographical in the ordinary sense, but when the two species inhabit what is nominally the same locality, they are found to be differently related to their environment, or related to different closely adjacent environments. Furthermore, they must breed true, and not ordinarily interbreed one with another.

This sounds simple enough, but the application of these principles is not so simple. In the diagram, the case of *b b* is obviously more like that of *c c* than it is like that of *a a*. The difference between a slight break and a slight connection is infinitesimally small, yet after all it is a real difference—something existing in Nature, and not subject to individual opinion. If this criterion is admitted, because of its capability of exact definition, then the whole series of birches discussed by Mr. Fernald must apparently be regarded as one species!

Another sort of case is offered by the plants of the Galapagos Islands, recently reviewed in a most valuable memoir by Dr. B. L. Robinson.[2] *Euphorbia viminea*, J. D. Hooker, has eight distinct forms confined to as many islands (one only being found on two). These plants are readily distinguishable, but their characters are such as would be ordinarily of no value for distinguishing species in the genus. On continental areas, similar species of Euphorbia are polymorphic, with innumerable similar variations connected by every sort of intermediate. Consequently, Dr. Robinson does not treat the Galapagos plants as separate species, or (with one exception) even as varieties, but as "forms." Now, according to the above definition of species, these plants are perfectly good species, for the breaks in continuity, slight as they are, appear to be absolute.

There is, perhaps, one way of escaping from this conclusion. Distinct species should not promiscuously interbreed; there should be some sort of "physiological" barrier. It is known, in the case of the ostensibly distinct species of Lavatera from the

[1] *Amer. Journ. Science*, xiv., September, 1902.
[2] *Proc.* Amer. Acad., October, 1902 (vol. xxxviii.).

islands off the coast of California, that this barrier does not exist. Perhaps, if the different Galapagos Islands forms of *Euphorbia viminea* were grown together, they would completely fuse and give a single promiscuously varying type like those of the continents. But, after all, the question is what they actually do, not what they might do, under hypothetical conditions. The answer to this question must be that they remain distinct.

It seems to the present writer that the only precise criterion of species must be a spacial one, just as the only reason for species is that of function, or the relation between the nature of the creature and the place it occupies. But, admitting this on philosophical grounds, we are forced to recognise species of every degree of distinctness, just as the geographer recognises islands separated by every sort of distance from the mainland. It is easier, no doubt, to accept instead the morphological criterion, and this is actually what we have to do in taxonomic work,[1] for lack of evidence of the other kind; but this leaves the whole matter to be decided by individual opinions, with results known too well.

It is probable, if not certain, that variable plants on continental areas produce many "temporary species." That is to say, local colonies become more or less differentiated and remain so until swamped by invasions of the parent form or some other variety. Whether we recognise these "temporary species" depends, in practice, upon the degree of difference exhibited. Not rarely, the distinctions are constant and marked over a certain area, but the very same distinctions elsewhere occur as individual variations in the midst of the parent species. I have recorded such cases in the genera Sphæralcea and Cleome.

At the close of his work on the Galapagos flora, Dr. Robinson presents a most lucid and philosophical discussion of the whole subject; it is so full of fact and thought that a brief summary could not do it justice. In particular, attention must be called

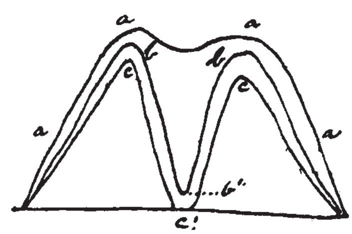

FIG. 1.

to his statement of the reasons why the local insular varieties persist in spite of the occasional infusion of new blood.

Mr. Carl Purdy's revision of the genus Calochortus[2] is another work of great interest. These beautiful "butterfly lilies" are extremely abundant in the Pacific region of North America, and are almost indefinitely variable. The variations are of all sorts, sometimes "constitutional" rather than morphological. Says Mr. Purdy, "In cultivation it has frequently been found that a very slight variability in strains is accompanied by a marked constitutional difference. In two beds of *Calochortus venustus*, planted in the same soil and separated only by a thin board, it would puzzle a botanist to state wherein the plants vary. They come from widely separated localities, and the difference is one more easily detected by the eye than conveyed by words. In one bed, two-thirds of the leaves are already destroyed by mildew (Botrytis), while in the other, not one leaf is injured; and such is the case whenever and wherever the two are planted" (p. 108). Mr. Purdy points out that in some localities the plants are very uniform, while in others they are extremely variable, with hundreds of distinguishable phases. It is probable that the phenomenon of "temporary species" is common in this genus, and the union of such morphologically, but not physiologically, distinct types is the cause of much variability. At the same time, there are species which always remain distinct, never producing fertile hybrids. That Mr. Purdy has tested so many of the forms for such "physiological barriers" gives his work especial value and importance. It does

[1] De Vries has assumed that, because botanists so distinguish species (admittedly of necessity), therefore the morphological criterion is the genuine one. Thus species have no better foundation in Nature than genera, which are wholly based on reasons of convenience.
[2] *Proc.* Calif. Acad. Sci., 3rd series, Botany, vol. ii. No. 4 (1901).